



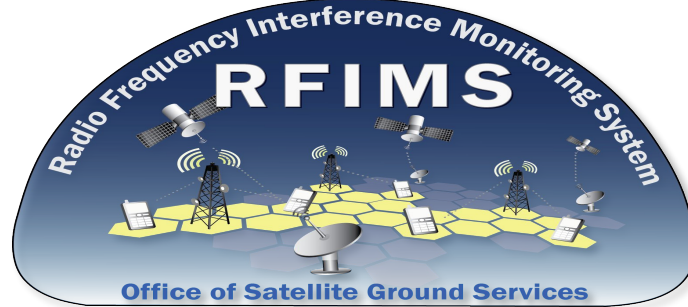
Radio Frequency Interference Monitoring System (RFIMS)

Data Collection System (DCS) Working Group

Steven Grippando

Ed White

April 28 , 2021



FOR OFFICIAL USE ONLY - Pre-decisional, Deliberative Information - NOT FOR PUBLIC RELEASE

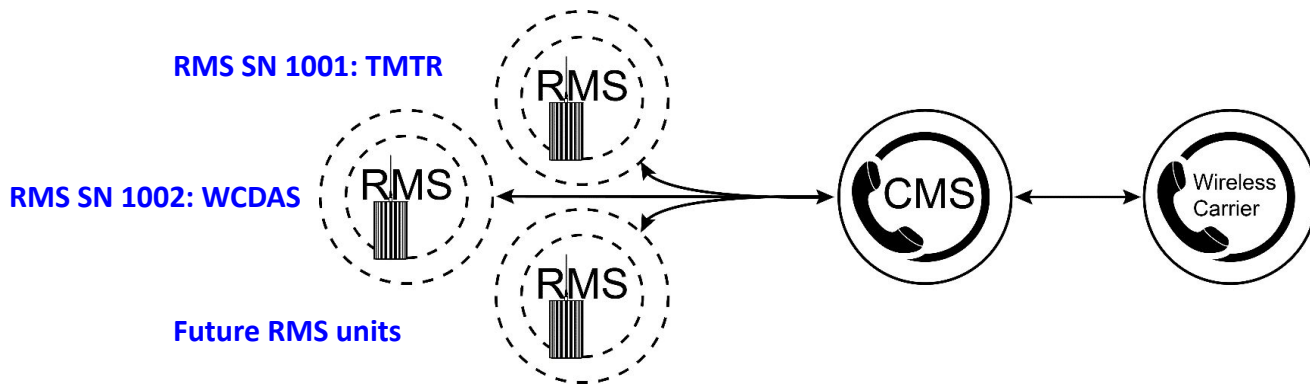


Agenda

- RFIMS Project Status
- CMS and RMS Deployments
- System Diagram
- Table Mountain Test Range (TMTR) Environment
- RFIMS Capability Assessment
- Table Mountain Test Range assets available for testing
- Next steps
- Questions

RFIMS Project Status

- RFIMS is a cloud-centric NOAA solution for spectrum sharing in L-Band supporting both NESDIS and NWS earth stations.
- The main component of the system is the cloud-based Central Monitoring System (CMS), while the Remote Monitoring System (RMS) was designed for deployment at earth stations with minimal equipment footprint.
- NOAA has deployed a CMS in the AWS GovCloud and two RMS units, one at the Table Mountain Test Range (TMTR) and the other at WCDAS. The RMS units at earth stations will process interference events and forward them to the CMS for further analysis and wireless carrier notification.
- Adding RMS units for future deployments (e.g., Miami and Fairbanks) will not substantially impact the system. However, each site may have specific installation requirements to address (e.g., network connectivity approach).





RMS Deployments

- RMS SN 1001
 - Deployed at the TMTR in Longmont, CO.
 - L3Harris performed operationally representative testing during live MetSat passes.
 - Site acceptance testing completed on March 08, 2021.
 - Currently connected to the CMS and the RFIMS PMO is performing centralizing monitoring.
- RMS SN 1002
 - Deployed at the WCDAS in Wallops Island, VA.
 - Radio frequency monitoring testing completed on February 10, 2021.
 - Formal testing conducted on February 24, 2021.
 - L3Harris shutdown the system following at completion of testing.
 - Working through the security approval process for NOAA 5044 network connectivity.

RMS Deployments (continued)

RMS SN1001: TMTR



RMS SN1002: WCDAS



RMS units consist of a trailer, radio cabinet, transportable tower, and antenna array.

RFIMS System Diagram

RMS

- Detects RFI from cell phones.
- Up to 17 RMS units.

Table Mountain Test Range

Internet via:
NTIA Admin
Guest LAN



WCDAS

Internet via:
MSL (FISMA:
NOAA5044)



Internet
VPN Tunnel
N-Wave

Internet
VPN Tunnel
N-Wave

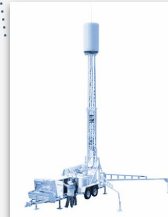
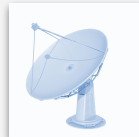
CMS

- Processing Software
- Data Archive
- User Interface
- Development Contractor-operated

AWS GovCloud (US):
Software, Data



Future RMSs



System Access

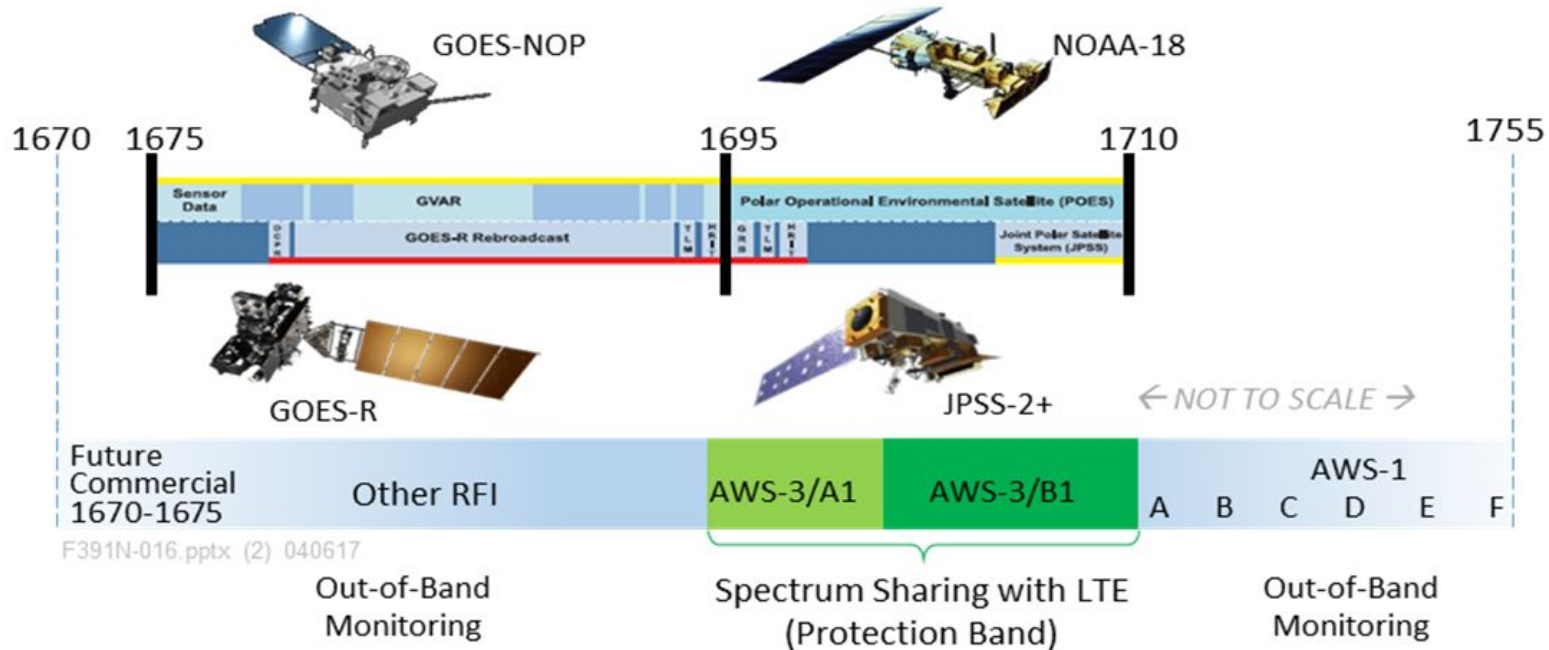


- RFIMS PMO
- Spectrum Mgrs.
- Site personnel
- Sys Admin

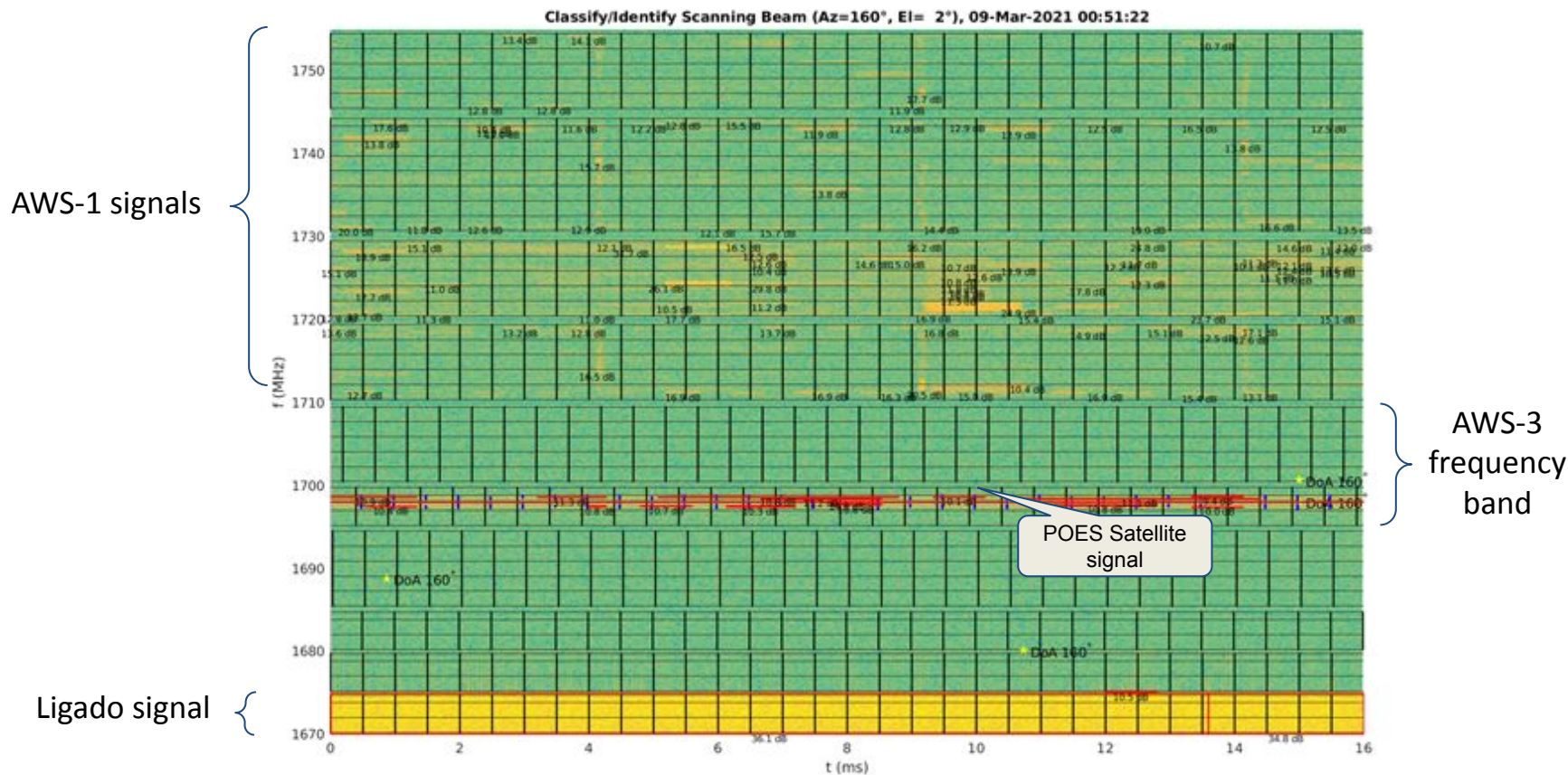
Internet
VPN Tunnel

RFIMS Frequency Range

- The RFIMS has a frequency monitoring range of 1670 - 1755 MHz and will detect, classify, identify, and notify of RFI occurring in the AWS-3 1695 - 1710 MHz band.
- Monitoring of the 1670-1680 MHz and 1710-1755 MHz bands is for operator situational awareness and engineering analysis, not formal RFI identification and notification.



RFIMS Spectrogram Output: NOAA 19 HRPT at 1698 MHz



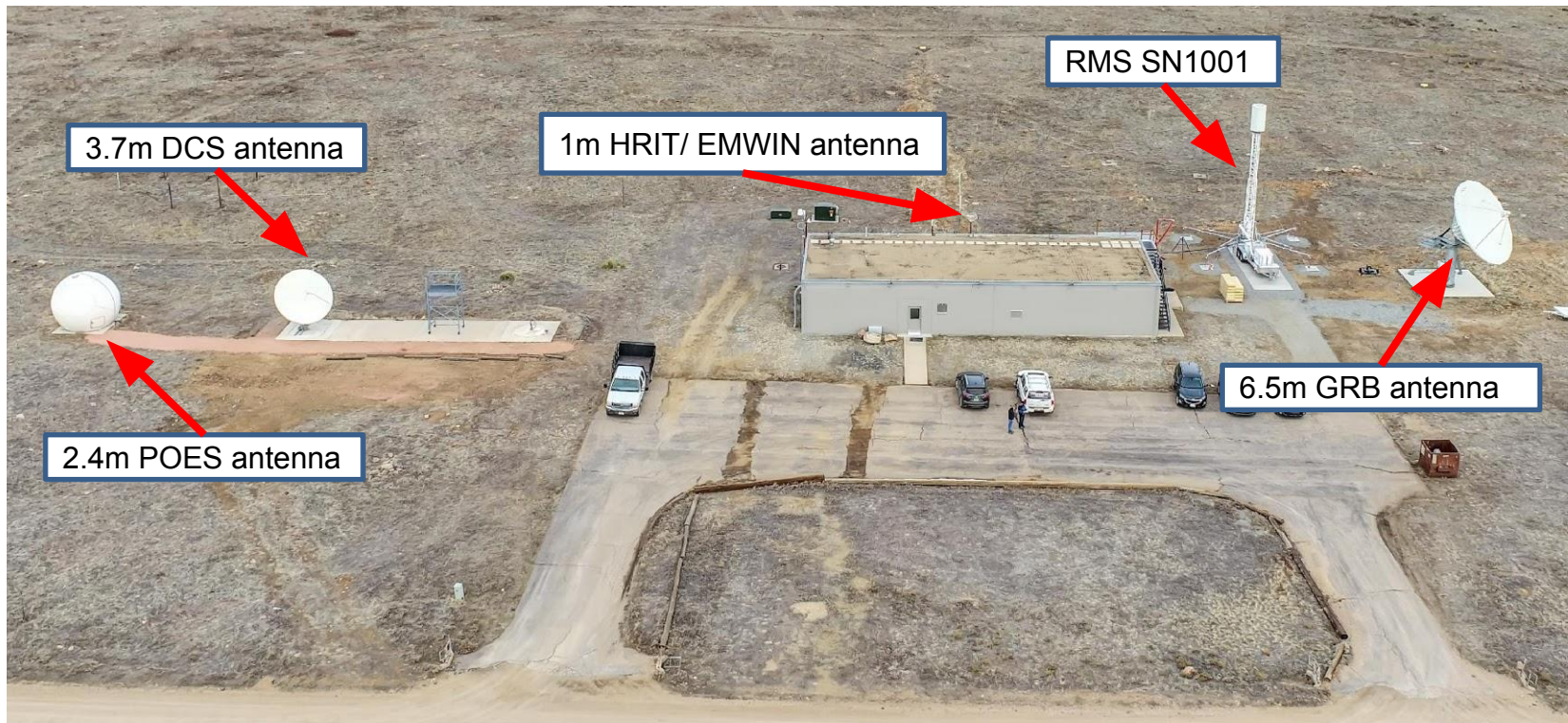


TMTR Earth Station Environment

- The TMTR is an operationally representative NOAA earth station environment for spectrum sharing studies and testing
- NOAA deployed the first RMS Unit SN1001 for acceptance testing.
- RFIMS PMO established POES, METOP, GOES-R Rebroadcast, DCS, and HRIT/ EMWIN ground stations to support RFIMS capability assessment testing.

Ground Station	Description
2.4-meter (m) L-Band Satellite Ground Station	Ground station system NOAA uses to receive and process POES/ METOP satellite downlink data.
6.5m GRB Satellite Ground Station	Ground station system NOAA uses to receive and process GOES-R GRB satellite downlink data.
3.7m DCS DRGS Ground Station	Ground station system NOAA uses to receive GOES-R satellite DCS rebroadcasts.
1m HRIT/ EMWIN Ground Station	Ground station system NOAA uses to receive GOES-R HRIT/ EMWIN broadcasts.

TMTR Earth Station Layout



DCS Ground Station

- RFIMS PMO installed a 3.7m Microcom GOES DCS Direct Readout Ground Station (DRGS) at the TMTR.
 - Similar system to NOAA operational systems at WCDAS and the NSOF.
 - DAMS-NT 16 channel cage with DigiTrak Demodulators, DAMS-NT server management software, and DAMS-NT client software.
- RFIMS PMO is preparing to conduct a DCS study to determine the system's interference susceptibility.
- The study may help NOAA better understand how the RFIMS can protect DCS reception during spectrum sharing.
 - Long-term Evolution (LTE) or 5G user equipment signal may interfere with DCS downlink.
 - Ligado transmissions may also create interference to DCS.
 - RFIMS can monitor 1670 – 1695 MHz, which includes DCS downlink of 1679.7 to 1680.1 MHz.



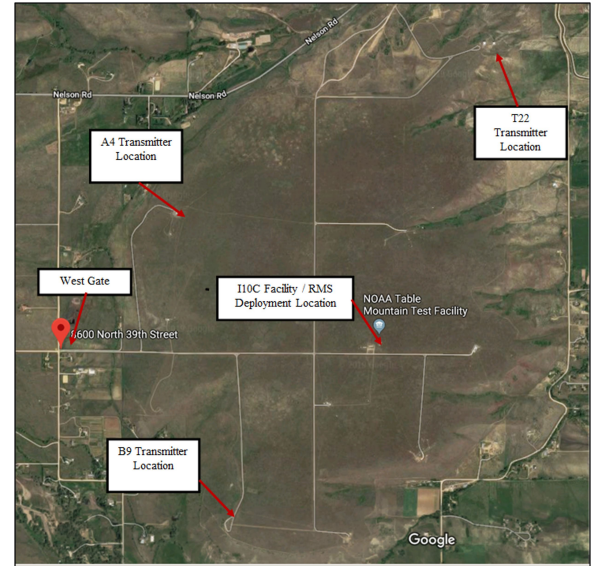


RFIMS Capability Assessment

- RFIMS PMO is conducting a capability assessment to validate the RFIMS's ability to support spectrum sharing in a NOAA satellite environment.
 - Objective is to provide an independent, objective, and quantitative assessment of the RFIMS's capability to support sharing of the 1695 – 1710 MHz band with AWS-3 wireless carriers.
 - Conducting testing at the operationally representative TMTR earth station environment.
- Validating RFIMS detection, classification, identification, and notification in presence of emulated LTE and 5G user equipment interference levels that impact NOAA earth stations.
 - Using Aerospace, MITRE, and NTIA ITS Spectrum and Propagation Measurements Division test systems to emulate LTE and 5G interference.
 - Conducting testing while operating POES, GRB, DCS, HRIT/ EMWIN ground stations to correlate RFIMS capability with interference thresholds that impact these NOAA systems.
 - Assessment results will inform decision-making at the Milestone 3.5 Full-Rate Production Decision Review scheduled Summer 2021.
 - Assessment results will inform DCS and HRIT/ EMWIN user groups.
- Capability assessment is currently in the planning and dry-run phase of the testing campaign.

TMTR Assets Available for Testing

- TMTR provides four potential RF transmission sites to transmit over-the-air LTE and other forms of RF interference signals.
 - Building I10C: a centralized location for management and execution of testing.
 - Remote Building A4: an optional location to install test tools for emulating wireless signals (e.g., LTE and non-LTE interference).
 - Remote Building B9: a second optional location to install test tools for emulating wireless signals.
 - Building T22: a third optional location to install test tools for emulating wireless signals.
- Four types of NOAA grounds station reception systems are available as the table below lists:



Ground Station	Description
2.4-meter (m) L-Band Satellite Ground Station	Ground station system NOAA uses to receive and process POES/ METOP satellite downlink data.
6.5m GRB Satellite Ground Station	Ground station system NOAA uses to receive and process GOES-R GRB satellite downlink data.
3.7m DCS DRGS Ground Station	Ground station system NOAA uses to receive GOES-R satellite DCS rebroadcasts.
1m HRIT/ EMWIN Ground Station	Ground station system NOAA uses to receive GOES-R HRIT/ EMWIN broadcasts.



Next Steps

- RFIMS PMO will complete capability assessment test planning with test stakeholders.
- Engage DCS Working Group to discuss measures and metrics the test team may consider for establishing interference protection criteria.
 - Typical latency performance and levels that create outages.
 - Pilot level, channel noise, phase noise
 - Other metrics operators have successfully used to manage DCS performance.
- Work with NTIA/ ITS to plan and complete DCS study (in early phase of discussions).
 - DCS test approach and plan, test procedures, and test results report.
 - Use test results to update capability assessment test procedures for correlating RFIMS testing while operating DCS in an emulated interference environment.
 - Conduct testing.
- Coordinate follow-up meetings with DCS Working Group to discuss test results and next steps in better understanding how the RFIMS can help protect DCS reception.

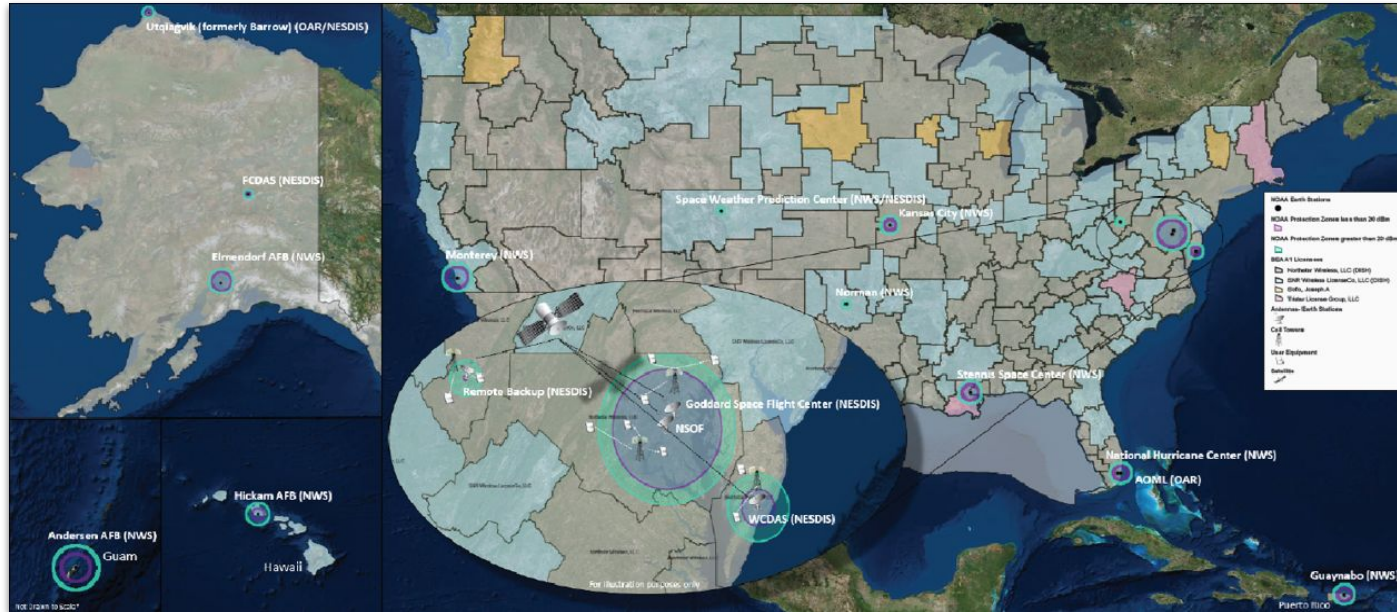


Questions



Backup

RFIMS Background

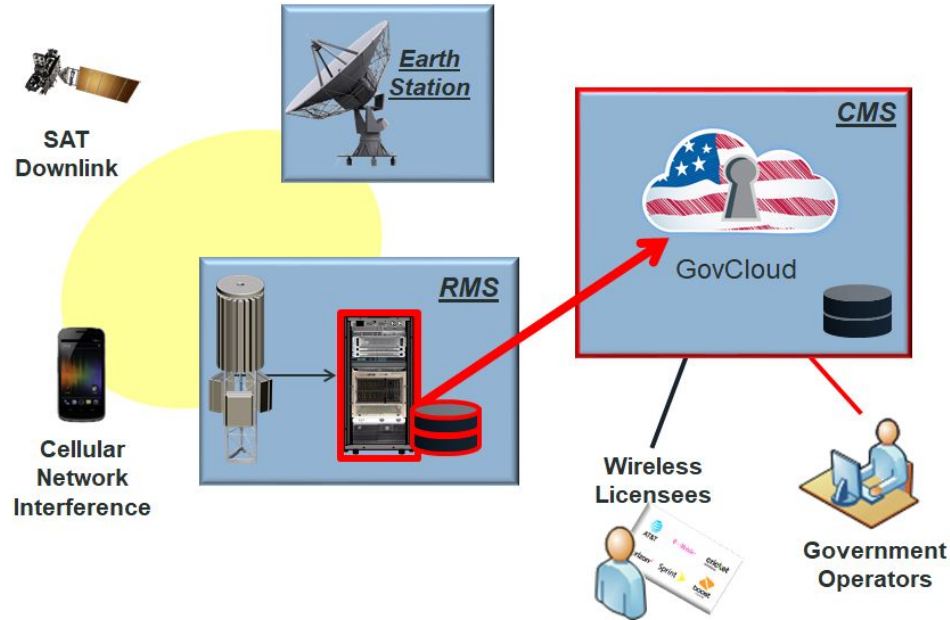


Ground Station	Mission	Protection Zone	Radius (km)
Fairbanks, AK	POES/GOES	Fairbanks	20
Anchorage, AK	POES	Elmendorf AFB	98
Barrow, AK	POES	Barrow	35
Monterey, CA	POES	Monterey	76
Boulder, CO	GOES	Boulder	2
Miami, FL(OAR)	POES	Miami	51
Miami, FL(NHC)	GOES		
Barrigada, GU	POES	Andersen AFB	42
Ford Island, HI	POES	Hickam AFB	28
Suitland, MD	GOES/POES	Suitland, Washington, DC	98
Greenbelt, MD	GOES		
Bay St. Louis, MS	POES	Stennis Space Center	57
Kansas City, MO	GOES	Kansas City	40
Norman, OK	GOES	Norman	3
Guaynabo, PR	GOES	Guaynabo	48
Wallops Island, VA	POES/GOES	Wallops Island	30
Fairmont, WV	GOES	Fairmont	4

The RFIMS Project will develop and deploy an RF interference monitoring capability for up to 17 NOAA satellite earth stations to protect weather satellite downlinks from AWS-3 licensee handset transmissions in the same frequency

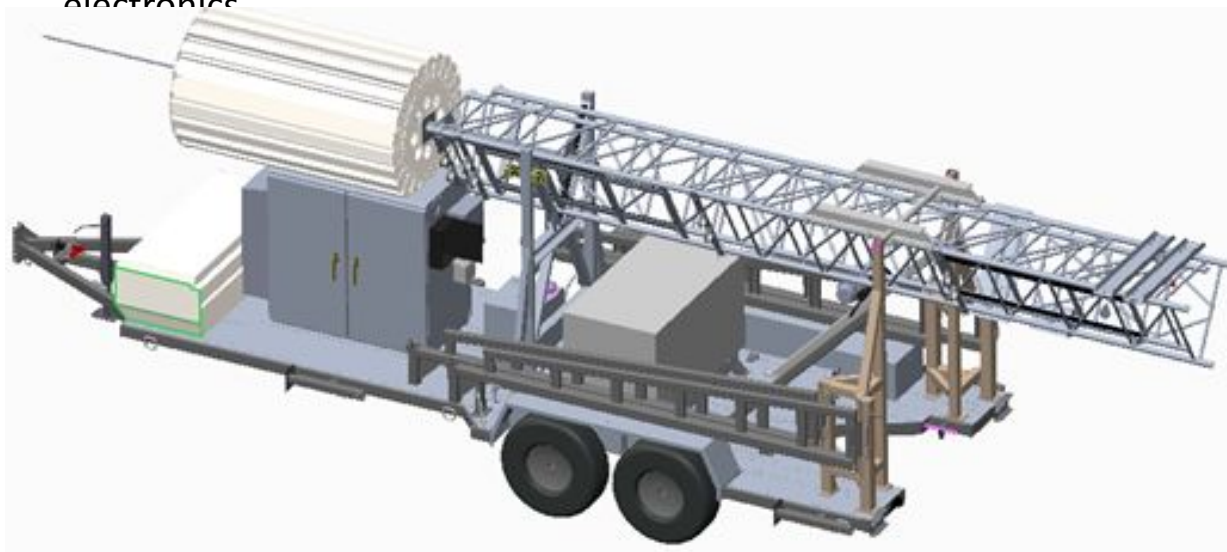
RFIMS Main Components

- The RFIMS has two main subsystems, the Remote Monitoring Subsystem (RMS) and Centralized Monitoring Subsystem (CMS).
- RMSs are deployed at designated earth stations to detect, classify, and identify RFI.
- CMS will exist in the Amazon GovCloud to store RFI data and notify NOAA and AWS-3 licensee operators.



RMS Components: RMS

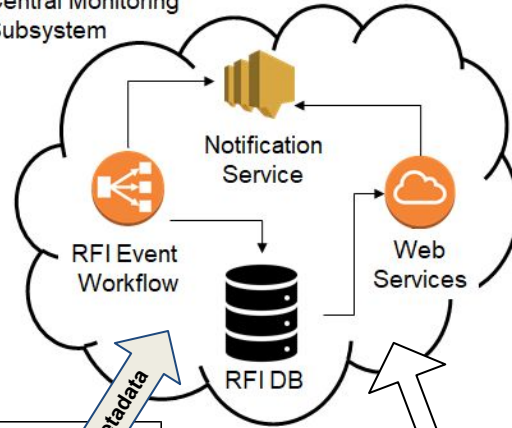
- RMS consists of three areas, trailer, radio cabinet, and antenna tower.
 - Trailer: the trailer, generator, and antenna storage.
 - Antenna tower: antenna and an erectable antenna mast.
 - Radio cabinet: digital processing, network communications, and supporting electronics



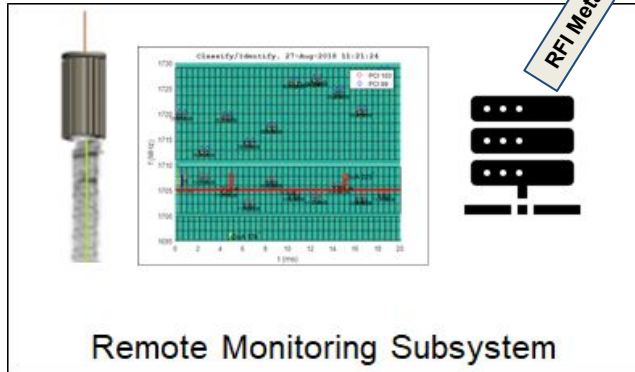
RFIMS Operation - Notification

Signal at the receiver ≥ -10
dB INR

Central Monitoring
Subsystem



RFI Metadata

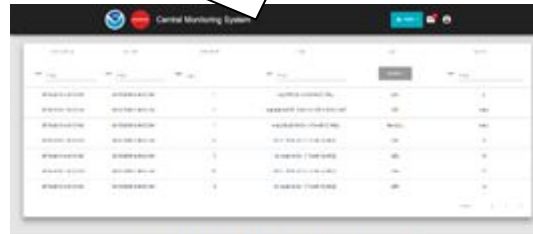


Notify
Stakeholders

Operations

Government
Analyst

Wireless
Carrier



The Incident Report is a screenshot of a web application titled "Central Monitoring System". It displays a table with incident data. The table has columns for "Incident ID", "Incident Name", "Status", "Priority", "Assigned To", and "Created Date". The data is organized into several rows, each representing a different incident.

Incident ID	Incident Name	Status	Priority	Assigned To	Created Date
2018-08-27-001	2018-08-27-001	Open	High	John Doe	2018-08-27 11:21:24
2018-08-27-002	2018-08-27-002	In Progress	Medium	Jane Smith	2018-08-27 11:21:24
2018-08-27-003	2018-08-27-003	Resolved	Low	John Doe	2018-08-27 11:21:24
2018-08-27-004	2018-08-27-004	Open	High	Jane Smith	2018-08-27 11:21:24
2018-08-27-005	2018-08-27-005	In Progress	Medium	John Doe	2018-08-27 11:21:24
2018-08-27-006	2018-08-27-006	Resolved	Low	Jane Smith	2018-08-27 11:21:24
2018-08-27-007	2018-08-27-007	Open	High	John Doe	2018-08-27 11:21:24
2018-08-27-008	2018-08-27-008	In Progress	Medium	Jane Smith	2018-08-27 11:21:24
2018-08-27-009	2018-08-27-009	Resolved	Low	John Doe	2018-08-27 11:21:24
2018-08-27-010	2018-08-27-010	Open	High	Jane Smith	2018-08-27 11:21:24

Incident Report